

What is claimed is:

1. Glass-ceramics having an average linear thermal expansion coefficient within a range of $0.0 \pm 0.2 \times 10^{-7}/^{\circ}\text{C}$ within a temperature range from 0°C to 50°C , having difference between the maximum value and the minimum value of $\Delta L/L$ of 10×10^{-7} or below, and comprising SiO_2 , Al_2O_3 and P_2O_5 with the total amount thereof in mass % being within a range from 86.0% to 89.0%.

2. Glass-ceramics as defined in claim 1 wherein the ratio of P_2O_5 to SiO_2 and the ratio of P_2O_5 to Al_2O_3 are

$$\text{P}_2\text{O}_5/\text{SiO}_2 \quad 0.1230 - 0.1450 \text{ and}$$

$$\text{P}_2\text{O}_5/\text{Al}_2\text{O}_3 \quad 0.270 - 0.330.$$

3. Glass-ceramics having an average linear thermal expansion coefficient within a range of $0.0 \pm 0.1 \times 10^{-7}/^{\circ}\text{C}$ within a temperature range from 0°C to 50°C , having difference between the maximum value and the minimum value of $\Delta L/L$ of 8×10^{-7} or below, and comprising SiO_2 , Al_2O_3 and P_2O_5 with the total amount thereof in mass % being within a range from 86.0% to 89.0%.

4. Glass-ceramics as defined in claim 3 wherein the ratio of P_2O_5 to SiO_2 and the ratio of P_2O_5 to Al_2O_3 are

$$\text{P}_2\text{O}_5/\text{SiO}_2 \quad 0.1230 - 0.1450 \text{ and}$$

$$\text{P}_2\text{O}_5/\text{Al}_2\text{O}_3 \quad 0.270 - 0.330.$$

5. Glass-ceramics as defined in claim 1 wherein surface roughness (Ra) (arithmetic mean roughness) is 3 \AA or below.

6. Glass-ceramics as defined in claim 1 wherein an average crystal grain diameter of precipitating crystal phase or phases is within a range from

50nm to 90nm.

7. Glass-ceramics as defined in claim 1 which comprise β -quartz (β -SiO₂) and/or β -quartz solid solution (β -SiO₂ solid solution) as a predominant crystal phase.

8. Glass-ceramics as defined in claim 1 which are free of PbO, Na₂O, K₂O and B₂O₃.

9. Glass-ceramics as defined in claim 1 obtained by heat treating, for crystallization, a base glass which comprises, in mass %,

SiO ₂	53 – 57%
P ₂ O ₅	7.0 – 8.5% and
Al ₂ O ₃	23 – 26%

and is substantially free of PbO, Na₂O, K₂O and B₂O₃, said glass-ceramics comprising β -quartz (β -SiO₂) and/or β -quartz solid solution (β -SiO₂ solid solution) as a predominant crystal phase.

10. Glass-ceramics as defined in claim 9 comprising, in mass %, Li₂O within a range of 3.5 – 4.5%.

11. Glass-ceramics as defined in claim 10 comprising, in mass %,

MgO	0.5 – 1.5% and/or
ZnO	0.1 – 1.5% and/or
CaO	0.5 – 1.5% and/or
BaO	0.5 – 1.5% and/or
TiO ₂	1.5 – 3.0% and/or
ZrO ₂	1.0 – 3.0% and/or

As₂O₃

0.5 – 1.0%.

12. Glass-ceramics as defined in claim 1 wherein the maximum temperature of the heat treatment for crystallization is within a range from 750°C to 800°C.

13. A mask for lithography using glass-ceramics as defined in claim 1.

14. An optical system reflecting mirror for lithography using glass-ceramics as defined in claim 1.

15. A wafer stage or a reticle stage for lithography using glass-ceramics as defined in claim 1.

16. A component part of a precision instrument using glass-ceramics as defined in claim 1.

17. Glass-ceramics as defined in claim 3 wherein surface roughness (Ra) (arithmetic mean roughness) is 3 Å or below.

18. Glass-ceramics as defined in claim 3 wherein an average crystal grain diameter of precipitating crystal phase or phases is within a range from 50nm to 90nm.

19. Glass-ceramics as defined in claim 3 which comprise β -quartz (β -SiO₂) and/or β -quartz solid solution (β -SiO₂ solid solution) as a predominant crystal phase.

20. Glass-ceramics as defined in claim 3 which are free of PbO, Na₂O, K₂O

and B_2O_3 .

21. Glass-ceramics as defined in claim 3 obtained by heat treating, for crystallization, a base glass which comprises, in mass %,

SiO_2	53 – 57%
P_2O_5	7.0 – 8.5% and
Al_2O_3	23 – 26%

and is substantially free of PbO , Na_2O , K_2O and B_2O_3 , said glass-ceramics comprising β -quartz (β - SiO_2) and/or β -quartz solid solution (β - SiO_2 solid solution) as a predominant crystal phase.

22. Glass-ceramics as defined in claim 21 comprising, in mass %, Li_2O within a range of 3.5 – 4.5%.

23. Glass-ceramics as defined in claim 22 comprising, in mass %,

MgO	0.5 – 1.5% and/or
ZnO	0.1 – 1.5% and/or
CaO	0.5 – 1/5% and/or
BaO	0.5 – 1.5% and/or
TiO_2	1.5 – 3.0% and/or
ZrO_2	1.0 – 3.0% and/or
As_2O_3	0.5 – 1.0%.

24. Glass-ceramics as defined in claim 3 wherein the maximum temperature of the heat treatment for crystallization is within a range from 750°C to 800°C.

25. A mask for lithography using glass-ceramics as defined in claim 3 .

26. An optical system reflecting mirror for lithography using glass-ceramics as defined in claim 3.

27. A wafer stage or a reticle stage for lithography using glass-ceramics as defined in claim 3.

28. A component part of a precision instrument using glass-ceramics as defined in claim 3.

29. Glass-ceramics as defined in claim 2 obtained by heat treating, for crystallization, a base glass which comprises, in mass %,

SiO ₂	53 – 57%
P ₂ O ₅	7.0 – 8.5% and
Al ₂ O ₃	23 – 26%

and is substantially free of PbO, Na₂O, K₂O and B₂O₃, said glass-ceramics comprising β -quartz (β -SiO₂) and/or β -quartz solid solution (β -SiO₂ solid solution) as a predominant crystal phase.

30. Glass-ceramics as defined in claim 29 comprising, in mass %, Li₂O within a range of 3.5 – 4.5%.

31. Glass-ceramics as defined in claim 30 comprising, in mass %,

MgO	0.5 – 1.5% and/or
ZnO	0.1 – 1.5% and/or
CaO	0.5 – 1.5% and/or
BaO	0.5 – 1.5% and/or
TiO ₂	1.5 – 3.0% and/or
ZrO ₂	1.0 – 3.0% and/or



0.5 – 1.0%.

32. Glass-ceramics as defined in claim 4 obtained by heat treating, for crystallization, a base glass which comprises, in mass %,



53 – 57%



7.0 – 8.5% and



23 – 26%

and is substantially free of PbO , Na_2O , K_2O and B_2O_3 , said glass-ceramics comprising β -quartz (β - SiO_2) and/or β -quartz solid solution (β - SiO_2 solid solution) as a predominant crystal phase.

33. Glass-ceramics as defined in claim 32 comprising, in mass %, Li_2O within a range of 3.5 – 4.5%.

34. Glass-ceramics as defined in claim 33 comprising, in mass %,



0.5 – 1.5% and/or



0.1 – 1.5% and/or



0.5 – 1.5% and/or



0.5 – 1.5% and/or



1.5 – 3.0% and/or



1.0 – 3.0% and/or



0.5 – 1.0%.